

Mathematics Games

with the alphabet



JOHN GOUGH

once again makes
the ordinary fascinating
as he piques our curiosity
about the origins
of the alphabet and
turns the various
mathematical properties
of letters into
bases for games.

Sometimes the first step towards making a new (mathematics) game is discovering an unexpected possibility in some hitherto unplayed-with piece of equipment. At other times the first step is inventing new equipment. But rarely is any 'new' idea for a game wholly original, either as a way of playing a game, or in its equipment. As letter-based word games, *Cross Words*, *Hang the Butcher* and the great classic word-spelling game *Scrabble* are familiar; but what else might we do with alphabet letters?

First, imagine that we have a set of 26 counters, each one marked, naturally, A, B, C, and so on, through the letters of the alphabet. This equipment could be the start of some interesting playing. I have never seen such a set, except as children's toy blocks. In fact I had just such a fascinating set, myself, as a very young child. Although it is unlikely that I learned to read by using my set of letter-blocks, I know I found them fascinating while I was learning my letters and learning to read.

Alphabet origins

Of course our ABC-abc alphabet has a significant history, and each letter has a life-story of its own — fascinating stuff to investigate. Consider Torbjorn Lundmark's *Quirky QWERTY: The Story of the Keyboard @ Your Fingertips* (2002). Lundmark discusses more than just our familiar 26 letters. Of course there are 52, when we allow for upper case and lower case (and what is the origin of these 'case'-terms?). Why, for example, is a capital S crossed to make a dollar sign, \$, and what is the meaning of the word 'dollar' and what does it have to do with 'dell' and 'dale' and 'vale' and 'valley'? He also outlines the history of the alphabet (and alphabeta, and alephbeth, from Ancient Egyptian through to Roman 'capitals' —

why are they called this? — and our modern letters), as well as giving a brief history of handwriting, punctuation, diacritical marks, page-layout, and counting and numeration systems! Why QWERTY, also?

Clive King's children's novel *The Twenty Two Letters* is an excellent and plausible fictional account of how Phoenician children may have adapted the known Egyptian hieroglyphics to represent sounds, at the time of the volcanic explosion on the island of Santorini or Thera which destroyed Minoan Crete and wrought havoc in the eastern end of the Mediterranean. In fact, the well-known Egyptian system of hieroglyphics was not, as is popularly supposed, 'picture writing', but was mainly a phonetic system that used picture-codes to represent consonant sounds. All the Phoenicians had to do was simplify the Egyptians' rebus-like pictures to character-like letters — vowel-letters developed later! — but what is a 'rebus'?

Rudyard Kipling's *Just So Stories* contains a much lighter and historically preposterous account of the development of our modern letters by a clever cave girl (and a use of concocted letter-like runes to encode a message to the reader — real runes are an alternative letter-system probably based on twigs rather than pictures). In fact there are two *Just So* stories about this marvellously sagacious child. It is in the second story that she invents the alphabet, but she needs to do this because in the first of her stories she creates much chaos by inventing a comic-strip version of picture writing, which was less than completely successful. Links between mathematics and Literature are always worth exploring, but I digress.

Make a set of letters

It is easy to make a set of alphabet-counters using the plastic bottle-tops from 2 and 3 litre bottles of milk, fruit juice and cordial: these are ideal counters for many kinds of make-it-yourself board games. Now we have the equipment, what shall we play with it?

Among other properties, each letter is a geometric object. First let me suggest that we can keep the possibilities of geometric complication as simple as possible by using plainly shaped letters, without the corner bits, the 'serifs', that are both decorative and an aid to letter-discrimination, and hence readability. So when I speak of capital A, for example, I have in mind an A in a 'sans serif' font, such as Helvetica, **A**, or Ariel, **A**, contrasted with the curly serifs of Times, T, or the rectilinear serifs of Courier, A, the font of old-fashioned electric typewriters. (Investigating the designs of fonts, and serifs, and the layout of typeset text, is a mathematical topic

in itself. Equally, the role of letter-frequency and letter-exchanges in codes and ciphers is a topic on its own, as is the computer-based ASCII code — American Standard Code for Information Interchange.)

We can use the geometric attributes of the letters of the alphabet, such as symmetry, open and closed figures, and straight and curved lines, as the basis for playing mathematics games. When we do so, it is worth recognising that these geometry-focussed games can be varied or extended by also using lower case letters, and other keyboard characters, including our ten digits, 1, 2, 3...

Alphabet attribute chains

This is a matching game, similar to dominoes. What is matched, in each turn, is some geometric attribute (but not reading/writing related attributes, such as sounds, rhyming, or being a vowel or a consonant) of the two immediately matched counters.

Geometric attributes for matching can include both letters having:

- a closed loop, e.g. R can match P, B, and A;
- a curve, e.g. S can match D, B, C, and R;
- no curve, e.g. L can match W, V, and A;
- line symmetry, e.g. V can match H, W or U;
- vertical reflection — being invertible or 'vertically-flippable', e.g. X can match O, I, and H;
- horizontal reflection — being 'side-ways-flippable', e.g. A can match H, W, and Y;
- the same number of straight-line segments, e.g. V, T and L match, as do W and M;

and so on.

The rules

- Two or more players shuffle the 26

letter-counters face-down, and deal them out evenly, leaving at least one aside. (Depending on the number of players there may be other counters not used).

- The last unshared letter-counter is placed in the middle of the table, face-up, to start the play.
- Players take it in turns to play one of their unused letter-counters at either end of a growing chain of letter-counters, so that the counter being placed ‘matches’ in some declared (and agreed) way, without using again any attribute that has already been used in the current game. Record each attribute as it used in the current game.
- If a player is unable to make a match to either end of the letter-chain, that player forfeits his or her move, and the next player can try to move.
- The winner is the last person able to make an acceptable correct move.
- Scoring is optional, either score 1 point for winning, or score the number of unplayed letter-counters still held by opponent(s), minus 1 point for each letter-counter still held by the winner.

secret (the It player) must truthfully answer ‘Yes’ or ‘No’.

- Questions can only be about geometric attributes of the letters (see above), so questions may NOT be about the letter-name, nor about whether the letter is a vowel or consonant, or can be used to spell a particular word or make a particular sound, or rhymes with some other word, or its alphabetical-order position, or coming before or after alphabetically some other designated letter).
- As the play progresses, players asking the questions may turn face-down those letter-counters that a question has now eliminated.
- After each question has been answered, the player who is asking the question may state which letter he or she thinks is the secret letter. But if this attempt to guess the letter is wrong, the It player receives 5 bonus points.
- Play continues until a player who is successful in stating the secret letter.
- The It player scores a point for every question asked by the other players.

Variant

If each player has a set of alphabet-counters, each player can secretly choose a letter for the other players to guess. The first player to successfully guess another player’s secret letter wins the game, and scores 1 point, plus any bonus points earned because the other player guessed wrongly (5 bonus points, per wrong guess), but subtracting any bonus points given to other players by guessing incorrectly at an earlier stage of the game.

Apart from being geometric objects, alphabet letters are ordered! We can build several games around the ordering process, combined with spatial thinking.

Guess which letter

This game is an alphabet-counter equivalent of the commercially made logic game *Guess Who?* So, the game requires deductive reasoning as well as the knowledge and language of the geometric attributes of the letters.

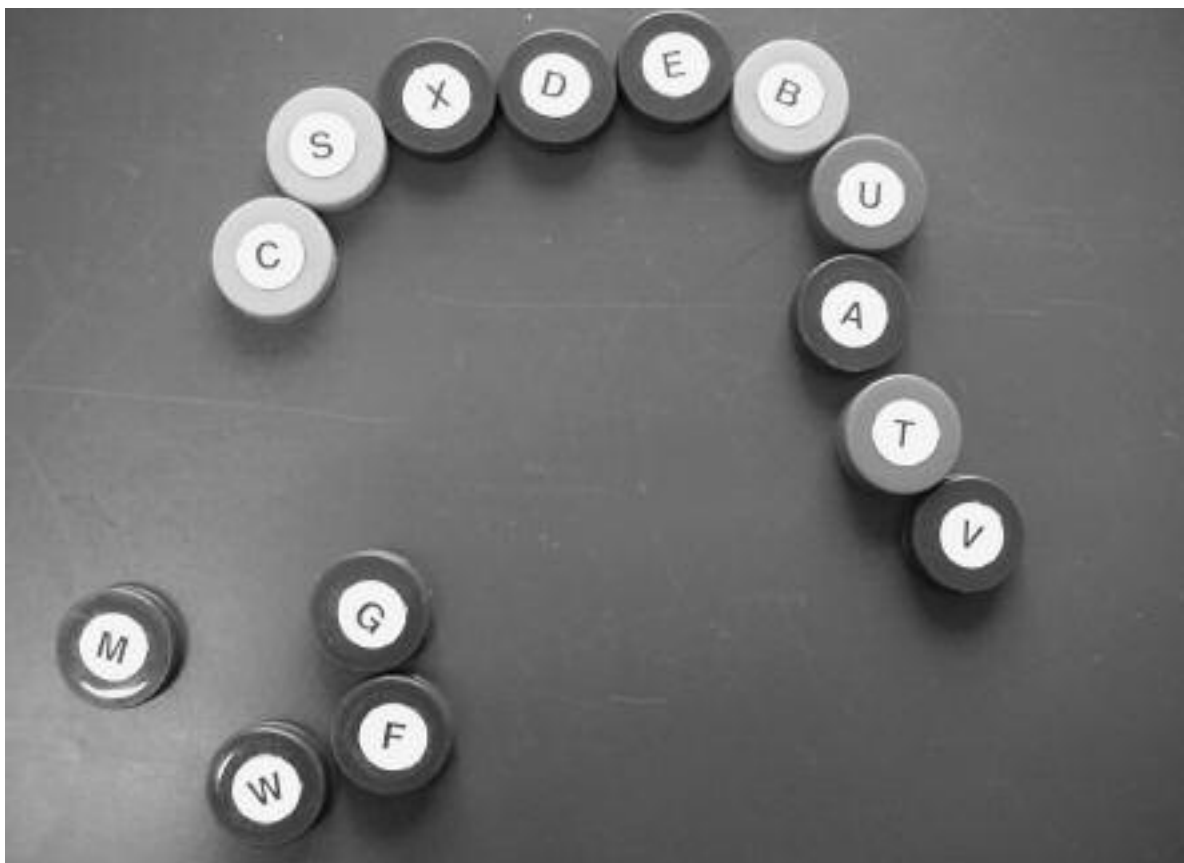
The rules

- Shuffle the letter-counters face-up. One player goes It, and secretly chooses any one of the letters, and secretly writes it down.
- Each other player then has a turn of asking a question about the secret letter, to which the player with the

Build a bridge

Two players use a set of 26 alphabet-counters and a 5×5 square-grid playing board (harder variants use a 6×6 or a 7×7 board). The grid-cells of the playing board must be large enough for a letter-counter to fit easily inside a grid-cell. The aim is to be the first player to complete a chain of counters that link opposite ends or sides of the board. One player aims to build a chain spanning across the board, from right to left, while the other tries to make the chain span from top to bottom. The ‘chain’ need not be a straight line, but must be joined through pairs of adjacent grid-cells, either horizontally, or vertically (but not diagonally).

The order of letters in the alphabet is used to determine the eligibility of a letter to be placed on the board. If a letter is placed BEFORE or ABOVE a letter that has already been placed, then it must come ALPHABETICALLY before that



letter, although it need not be the immediately previous letter in alphabetical sequence. Similarly, if a letter is placed AFTER or BELOW a letter already placed, it must come alphabetically after that letter, although it does not have to be the immediate next letter in the alphabet.

The rules

- The letter-counters are shuffled, face-down. Then each player is dealt four letters, and may look at his or her letters (and may conceal them from the other player).
- One more letter is turned face-up and placed in the centre grid-cell of the board, to start the possible chain-building process.
- Players then take turns. In each turn a player places one of his or her letter-counters face-up in an empty grid-cell on the board, so it comes before or after (horizontally) or above or below (vertically) one of the counters already on the board. The rule for doing this is based on alphabetical ordering (see above).
- Once a player successfully places one counter, the player's turn ends with the player taking one of any remaining undealt face-down letter-counters.
- If a player is unable to place a counter the player draws one of any remaining undealt face-down letter-counters, and the player's turn ends.
- The winner is the first player able to complete a chain of

letter-counters from one edge of the board to the opposite edge, as described before.

- The grid-cells in the corners of the board can count as part of an edge for either player's chain-making.
- The winner scores the number of unplayed letter-counters.

Who's closest?

This game is a little like ordering numbers on a number line, but uses the fixed sequence of letters in the alphabet instead.

The rules

- Two or more players are dealt 5 letter-counters each. Then one letter-counter is turned face-up, and this becomes the current target letter.
- Players then each place one of their letter-counters near the target-letter. The player whose

letter-counter is CLOSEST in alphabetical ordering to the target-counter, either alphabetically before or after the target letter, wins that round of play; that player scores 1 point.

- If two players are equally close (one before and one after the target letter, alphabetically), both players score 1 point.
- After each round of play, the used letter counters are moved aside, and a fresh target letter is selected, and turned face-up, and each player draws one further letter-counter from the unused counters, if possible.

AlphaStrings

This is an alphabetical ordering, spatial thinking, strategy board game. Two players use a set of 26 letter-counters, and a 4×4 square grid board, with pencil and paper for scoring. Players begin by placing all the counters face-down, and shuffling them, then randomly drawing 5 counters. The remaining counters are placed face-down on the grid, one counter in each grid-cell.

The rules

- Each player secretly looks at the letters on the face of his or her counters. If players are not satisfied with their counters they may take turns to exchange, face-down, a maximum of 3 of their counters with any of the face-down counters on the board, exchanging one counter at a time.
- When any exchanges are completed the 16 counters on the board are turned face-up. Players then begin playing, taking turns.
- In each turn a player may:
 - use one of his or her 5 counters to capture an ‘alpha string’ of counters, where such a ‘string’ starts with the player’s own tile followed by at least one of the letter-counters on the board and possibly other counters that are successively strung together (that is, successively step-by-step adjacent horizontally, or vertically, or diagonally), with the whole ‘string’ of counters being in precise alphabetical order. Captured and used letter-counters are removed from the board and put aside;
 - move any one of the counters in the grid one ‘step’ (horizontally, vertically, or diagonally) into an empty cell, providing that such a move is not simply undoing the previous player’s move. (Note that initially there are no spaces on the board. Hence the first turn must be a ‘capture’.)

- Play continues until both players have used their 5 counters to capture strings. The winner is the player who captures more of the letter-counters.

Variants

Allow players to use one of their 5 letter-counters as the last letter in an alpha string of letter-counters on the board. Do not allow exchanges at the beginning.

References and further reading

- King, C. (1966). *The Twenty-Two Letters*. London: Hamish Hamilton.
- Kipling, R. (1902). *Just So Stories*. London: Macmillan.
- Lundmark, T. (2002). *Quirky QWERTY: The Story of the Keyboard @ Your Fingertips*. Sydney: University of New South Wales Press.

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